REMARKS

Applicants respectfully request reconsideration of the present application in view of the reasons that follow.

Claims 1-57 are now pending in this application. Claims 29-57 are withdrawn from consideration. Claim 1 has been amended to clarify the scope of the term "only", as agreed to in the interview. No claims have been added or cancelled and no new matter has been added.

I. Interview Summary

Applicants appreciate the courtesy extended by Examiner Tran in conducting a telephone interview with the undersigned representative on October 14, 2005. During the interview, the examiner requested that applicants amend claim 1 by adding the term "only" before the term "liquid" to distinguish the claimed liquid metal from a semi-solid metal which contains a liquid phase.

The examiner agreed that the arguments presented below would be sufficient to overcome the 35 USC 103(a) rejection of claim 1, if claim 1 was amended to recite the term "only" before the term "liquid". In reply, applicants agree with the examiner's helpful suggestion and hereby amend claim 1 as suggested by the examiner. Applicants believe that claims 1-28 should now be in condition for allowance.

II. Rejoinder requested

Claims 29-57 are withdrawn from consideration. Applicants respectfully request that claims 29-57 be rejoined with claim 1 upon allowance of claim 1.

III. The 103(a) rejections should be withdrawn

Claims 1, 2, 4-14 and 15-17 have been rejected under §103(a) as being obvious over Mehrabian (U.S. Patent Number 3,936,298) in view of Shibata (U.S. Patent Number 6,478,075) and further in view of Apelain (U.S. Patent Number 4,902,475). This rejection is respectfully traversed.

None of the three references teach or suggest combining a separate first solid metal portion and a separate second liquid metal portion in a first chamber of an injection molding machine to form a semi-solid metal slurry, as recited in claim 1 of the present application. Thus, even if there is motivation to combine the three references, the combination would still not teach or suggest each claim limitation.

A. Mehrabian

The Office Action asserts that Mehrabian teaches combining a first solid metal to a second liquid metal in col. 4, lines 35-37. Applicants respectfully disagree.

Mehrabian actually teaches to cooling a liquid metal to form a semi-solid metal slurry and then adding solid particles to the semi-solid slurry in col. 4, lines 35-37. Thus, Mehrabian teaches to combine solid particles with a semi-solid slurry. However, Mehrabian does not teach to combine separate solid and liquid portions, as recited in claim 1 of the present application.

Specifically, in col. 4, lines 35-37, Mehrabian teaches to partially solidify a liquid metal by cooling the liquid metal to form a semi-solid slurry comprising first metal particles (i.e., primary solid phase of the semi-solid slurry) in a liquid phase (i.e., the secondary liquid phase of the semi-solid slurry). Mehrabian then teaches to add solid particles (third phase) to the semi-solid slurry.

This process is described in more detail in col. 5, line 65 to col. 6, line 30 of Mehrabian. First, the metal melt 1 is heated into the liquid phase (col. 5, line 65 to col. 6, line 1). Then, the liquid metal is cooled to form some solid metal particles in the liquid, which results in the semi-solid composition (col. 6, lines 10-12). A separate solid metal is not introduced into the liquid metal.

Then, the semi-solid composition is agitated by rotating blades 4, 4' to form a semi-solid slurry (col. 6, lines 1-5 and 15-20). Finally, the solid particles are introduced into the semi-solid slurry (col. 6, lines 20-24). This general method is explained in more detail with respect to actual compositions in the examples in columns 6-8 of Mehrabian.

Thus, in no point in the process described in col. 3, line 65 to col. 4, line 30 of Mehrabian are separate solid and liquid portions combined, as recited in claim 1 of the present application. In fact, the teaching of Mehrabian as a whole teaches away from mixing solid metal particles with a liquid metal to form a semi-solid metal slurry.

B. Shibata

Shibata also does not teach or suggest combining separate solid and liquid portions, as recited in claim 1 of the present application.

Shibata teaches melting solid metal into molten (i.e., liquid or semi-solid) metal in a furnace, then providing the molten metal into the shot sleeve, cooling the molten metal to the semi-solid state and then injecting the semi-solid metal into the mold. Specifically, Shibata discloses a method in column 9, line 16 to column 10, line 4, where molten aluminum 20 is provided from a holding furnace 10 into a casting sleeve 2 through feed pipe 8 (see col. 9, lines 16-17). The molten metal has a temperature between 10 °C below the liquidus and 40 °C above the liquidus (col. 7, lines 43-45). Thus, the molten metal is either in the liquid state when its temperature is above the liquidus or in the semi-solid state when its temperature is slightly below the liquidus. The molten aluminum 20 is allowed to cool and partially solidify in the casting sleeve into the semi-solid state (col. 9, lines 52-58). The semi-solid aluminum is then injected by a plunger 5 into the mold from the shot sleeve 2 (col. 9, line 65 to col. 10, line 4).

At no point during the process of Shibata is a separate solid metal portion combined with a separate liquid metal portion, as recited in claim 1 of the present application. Col. 7, lines 39-50 of Shibata cited in the Office Action does not disclose combining solid and liquid metal. Instead, col. 7, lines 39-50 of Shibata discloses a single molten metal portion comprising metal in the semi-solid state or the liquid state which is provided into the sleeve.

The recitation in claim 1 of combining a first solid metal portion and a second liquid metal portion to form a semi-solid slurry is not the same as formation of the semi-solid metal of Shibata because in the method of Shibata, there is no step of combining solid and liquid metal portions to form the semi-solid metal. Instead, a portion of a liquid (or semi-solid)

metal of Shibata is solidified into crystals to form the semi-solid metal. Thus, in the method of Shibata, liquid metal is converted to semi-solid metal and there is no step of combining liquid and solid metal portions to form the semi-solid metal.

C. Apelain

Apelain was relied upon in the Office Action for the teaching of aluminum grain refining agent composition in aluminum. However, Apelain does not teach or suggest combining separate first solid metal portion and second liquid metal portion in a first chamber of an injection molding machine to form a semi-solid metal slurry, as recited in claim 1. Thus, Apelain does not remedy the deficiency of Mehrabian and Shibata.

D. Combination of References Does Not Teach Limitations of Claim 1

Even if there was motivation to combine Mehrabian and Shibata, then the combination would still not teach combining separate solid and liquid portions, as recited in claim 1 of the present application, because neither of these references teaches such a step. At best, one of ordinary skill in the art would be motivated by the combination of references to combine semi-solid metal with solid metal as taught by Mehrabian and then inject this combined slurry into a mold as taught by Shibata.

E. No Motivation to Combine Mehrabian and Shibata

Page 3 of the Office Action states that the motivation for combining Mehrabian and Shibata is "to use the injection molding apparatus of Shibata et al. in Mehrabian in order to cast the semi-solid metal." This is not a proper motivation to combine references.

Both Mehrabian and Shibata teach different methods of forming semi-solid metal. The Office Action does not describe any advantage from the combination or any suggestion in one of the references that would lead one of ordinary skill in the art to make the combination.

In other words, Mehrabian and Shibata teach independent methods of making a semi-solid slurry. One of ordinary skill in the art would not need to use the apparatus of Shibata in the process of Mehrabian to cast semi-solid metal because one can use the apparatus of

Mehrabian to cast semi-solid metal. Therefore, there is no motivation to combine these references.

F. Rejection of Dependent Claims over Nakao

Claims 3 and 18-28 are rejected under § 103(a) as being unpatentable over Mehrabian Shibata and Apelain and further in view of Nakao (US Patent Number 6,505,670). This rejection is respectfully traversed.

Nakao teaches a method in which a solid aluminum billet 48 is combined with semi-solid aluminum 41 in an injection chamber 25. For example, col. 9, lines 5-13 of Nakao states that Al alloy 41 in the half-solidified state (i.e., the semi-solid state) is fed to the injection chamber 25 over a solid aluminum billet 48. Thus, a semi-solid metal contacts a solid metal billet. Thus, the method of Nakao is similar to the method of Mehrabian where semi-solid metal contacts solid metal.

However, Nakao does not teach or suggest a method in which a separate solid metal is combined with a separate liquid metal to form a semi-solid slurry, as recited in claim 1 of the present application.

Nakao also teaches that a molten metal matrix composite (i.e., Al and SiC) 42 is placed on top of the semi-solid aluminum 41 in the chamber 25. However, the metal matrix composite does not come into contact with the solid billet 48. In the method of Nakao, the billet 48 is first melted by the semi-solid aluminum 41. Then, the metal matrix composite 42 is provided over the semi-solid metal 41. Thus, the billet 48 is melted into the semi-solid aluminum 41 before the metal matrix composite 42 is provided into the chamber 25 (see col. 9, lines 5-24 and Figures 13-14 of Nakao).

Therefore, Nakao explicitly teaches to keep the solid billet 48 from coming into contact with the molten metal matrix composite 42.

Thus, even if there was motivation to combine Mehrabian, Shibata, Apelain and Nakao, then the combination would not teach or suggest all claim limitations. Neither Mehrabian, Shibata nor Nakao teach combining liquid and solid metal to form a semi-solid

slurry. In fact, Nakao teaches not to contact the solid billet with the molten metal matrix composite. Therefore, even if Mehrabian, Shibata and Nakao are combined, the combination would not teach or suggest combining liquid and solid metal to form a semi-solid slurry.

G. Claims 21-22

The Office Action states on page 4 that it is obvious to have a surface area to volume ratio of greater than 10:1 because it depends on the cast product. Applicants respectfully disagree.

Claims 21-22 recite a surface area to volume ratio of the second cavity portion that is used to form the third solid metal portion (i.e., the heat sink) that is provided back into the shot chamber. Thus, the second cavity portion is not used to form a product but a heat sink which is provided back into the shot chamber. Therefore, the dimensions of the second cavity portion recited in claims 20-21 do not depend on the cast product.

Applicants also note that Nakao teaches that it is necessary to press the billet 48 into a flat shape (see Figures 8-9 of Nakao) before melting the billet. In contrast, by forming the heat sink with the claimed high surface area ratio of claims 21-22 directly in the mold, the heat sink has a high surface area and the billet pressing step of Nakao can be avoided.

H. Claim 23

Claim 23 recites that the secondary cavity portion mentioned above contains fins or spikes. Thus, a finned or spiked heat sink is produced which is then provided back into the shot chamber. There is no teaching or suggestion in Nakao to make a finned or spiked heat sink.

I. Claims 25-26

The Office Action states on page 4 that it is obvious to have width at least two times greater than the depth because it depends on the cast product. Applicants respectfully disagree.

Claim 25 recites the dimensions of the shot chamber and the melt in the shot chamber, where the shot chamber width is at least twice the depth of the melt in the shot chamber. The dimensions of the shot chamber do not depend on the final cast product, since only the dimensions of the mold cavity determine the shape and size of the final cast product. There is no teaching or suggestion in the applied prior art to use the shot chamber recited in claim 25.

Furthermore, as recited in claim 26, the slurry contains a globular or equiaxed primary phase microstructure without stirring the slurry when the shot chamber of claim 25 is used. There is no teaching or suggestion in the applied prior art to use the method recited in claim 26.

IV. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date October 18, 2005

By Thomas S. Radomsky Reg. No. 43,438

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5300
Facsimile: (202) 672-5399

Leon Radomsky
Attorney for Applicant
Registration No. 43,445